

Operationally Responsive Spacecraft Subsystem, Phase I

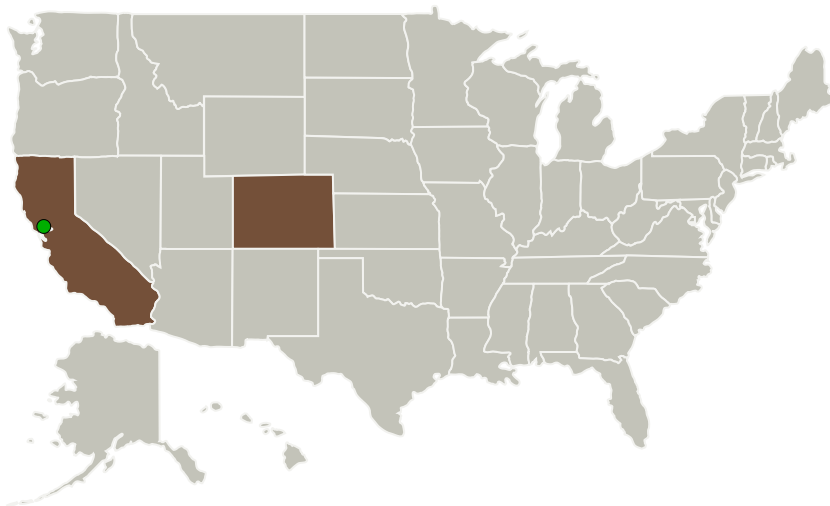
Completed Technology Project (2014 - 2014)

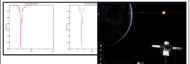


Project Introduction

Saber Astronautics proposes spacecraft subsystem control software which can autonomously reconfigure avionics for best performance during various mission conditions. The approach is to construct performance metrics from spacecraft health and welfare telemetry and learn their relationships in a probabilistic, multi-modal model called a "System Map". In this way the relationships between consumables, mission performance, and spacecraft subsystems can be learned in the same data driven model. The significance of the innovation is the ability for immediate, accurate real time assessment of the spacecraft systems-of-systems performance. Immediate assessment leads to immediate action, so the System Map is useful for any spacecraft reconfiguration task, spacecraft repair task, or mission decision assessment. It can be used in a fully autonomous, decentralized fashion by implanting on an FPGA as investigated in this proposal, or as a decision aid for a human crew.

Primary U.S. Work Locations and Key Partners



Spacecraft and Mission Autonomy Software, Saber Astronautics	
Objectives	Current Status
Software which provides accurate run time assessment of spacecraft systems of systems status. Probabilistic: focus on how mission decisions affect consumables and how consumables affect mission. Software can drive FPGAs for avionics which reconfigure to best survivability of the mission.	 • Approach validated on NASA ACE satellite data (8-yr accuracy >99%) • Focused on space-weather and satellites • Handles complexity, dynamics and emergence • Predictive Groundstation Project goes operational for commercial sub-orbital missions in Q2 2014
Saber's Approach	Key Milestones
• System of Systems Engineering • Predictive Modeling without Expert Domain Knowledge • Dynamic Bayesian Network, Gaussian Mixture Models • 3D Graphical Data Interface - reduced cognitive overload J. Hall, Saber Astronautics A. Green, Saber Astronautics W. Butler, Saber Astronautics 01/14	Systems Analysis 06/14 Data Collection and Preparation 07/14 Train AI Models 09/14 Experiments / Reporting 11/14 TRLin = 4

Operationally Responsive
Spacecraft Subsystem Project
Image

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Organizations Performing Work	Role	Type	Location
Saber Astronautics, LLC	Lead Organization	Industry Veteran-Owned Small Business (VOSB)	Austin, Texas
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations

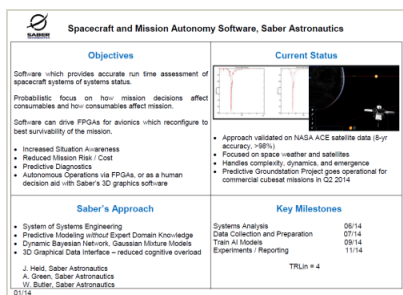
California	Colorado
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Project Transitions

**June 2014:** Project Start**December 2014:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/137757>)

Images



Project Image

Operationally Responsive
Spacecraft Subsystem Project
Image

(<https://techport.nasa.gov/image/132187>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission
Directorate (STMD)

Lead Organization:

Saber Astronautics, LLC

Responsible Program:

Small Business Innovation
Research/Small Business Tech
Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

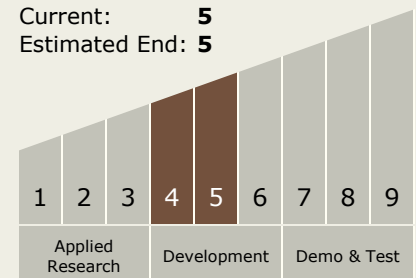
Carlos Torrez

Principal Investigator:

Jason Held

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX10 Autonomous Systems
 - └ TX10.2 Reasoning and Acting
 - └ TX10.2.2 Activity and Resource Planning and Scheduling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System